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ICECAP/ICEBRIDGE progress to date

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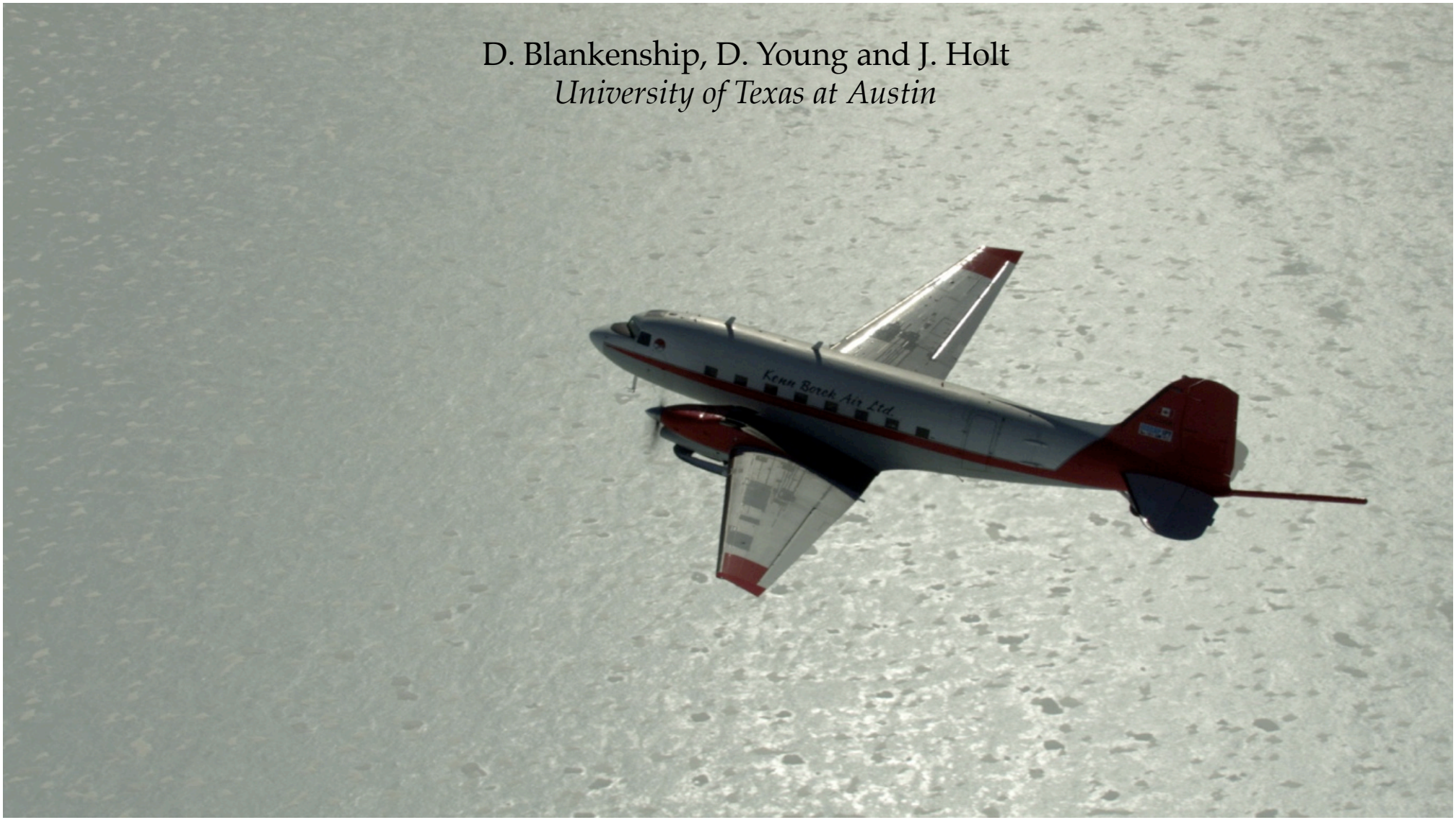

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The ICECAP project, beginning in 2008, with is a three year aerogeophysical survey of the East Antarctic Ice Sheet, focusing on:
1.boundary conditions on the long term evolution of the EAIS
2.searching for sites with a long climate record
3.constraining the short term response of the EAIS to climate change

ICECAP is an international effort supported by the UK's NERC, NSF, the Australian Antarctic Division and France's IPEV. ICECAP uses a turbine powered, ski-equipped DC-3T with the capacity to work out of coastal Antarctic stations

In the 2009/2010 season, ICEBRIDGE supplemented the 36 day ICECAP project with 36 days of additional survey time. Reflights of ICESAT orbital tracks and dense surveys of outlet glaciers were added to the regional ICECAP survey.

ICECAP Season 2 will not conclude until February 15th - due to an ongoing NASA endorsed collaboration in the Peninsula.

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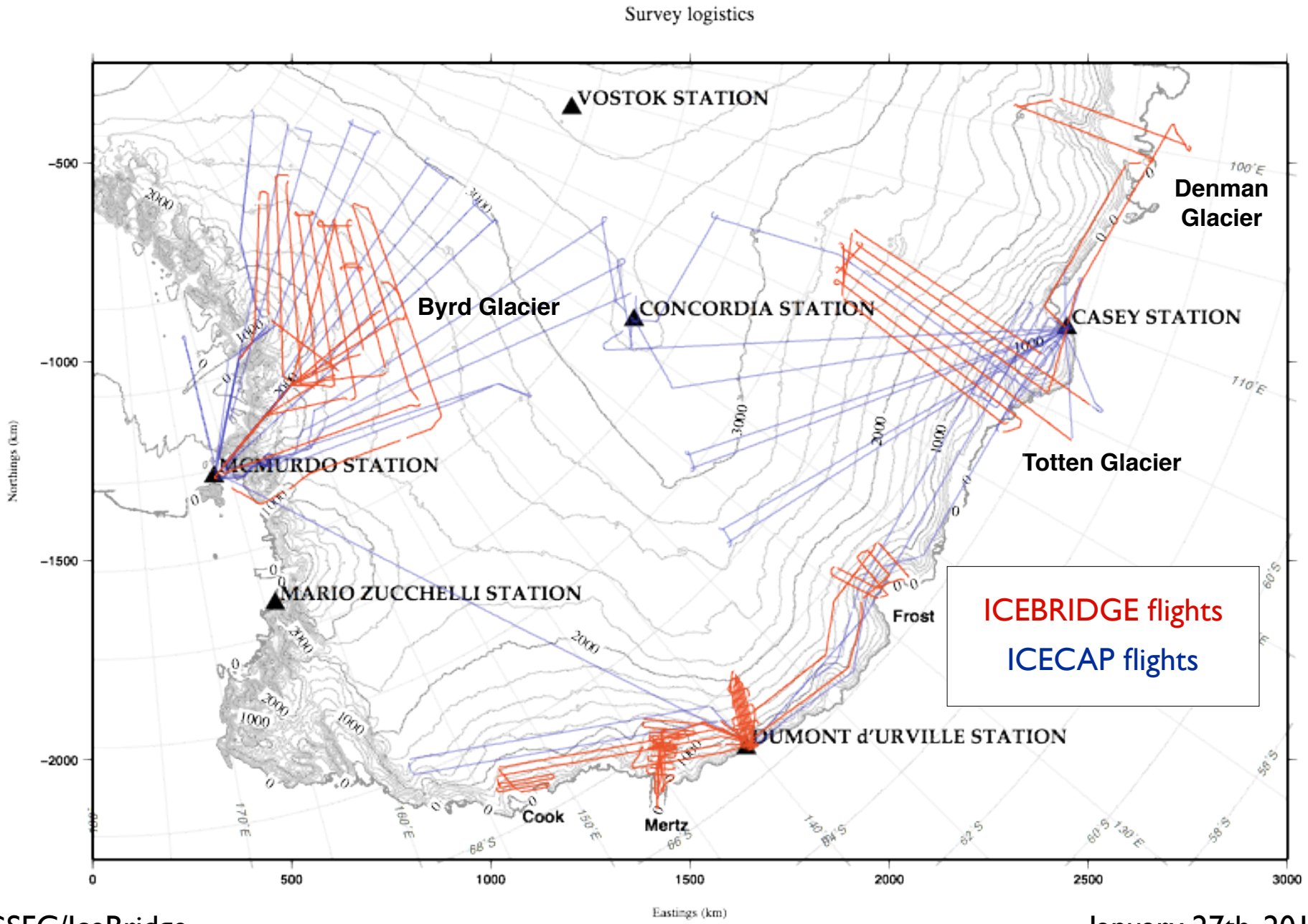

GSFC/IceBridge

January 27th, 2010

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Combined ICECAP+ICEBRIDGE 2009-2010 survey status (fourteen days of installation and testing in Calgary and McMurdo; 32 days of flight opportunities over the 59 day EAIS survey):

McMurdo Survey (Nov 10-Dec 10)

- 105 hours of 60 MHz radar, magnetics, and laser altimeter data (28,000 line km);
- 86 hours of photon counting imaging lidar data
- 62 hours of gravity data
- **Seven ICEBRIDGE targeted flight days over the Byrd Glacier lake district**

Casey Survey (Dec 12-Dec 28):

- 72 hours of 60 MHz radar, laser altimeter data, gravity+magnetics, and photon counting imaging lidar (18,000 line km)
- **Four ICEBRIDGE targeted flight days over Totten and Denman Glaciers**

Dumount d'Urville Survey (Dec 29-Jan 8):

- 47 hours of 60 MHz radar, laser altimeter data gravity+magnetics and photon counting imaging lidar (14,000 line km)
- 31 hours of 2.5 MHz ice penetrating radar data
- **Five ICEBRIDGE targeted flight days over Astrolabe, Frost, and Mertz Glaciers and Cook Ice Shelf**

Peninsula (Jan 15-Feb 15; IN PROGRESS):

- Ongoing collaboration with the Technical University of Denmark and the National Geospatial Intelligence Agency operating out of Argentine facilities in the Antarctic Peninsula to complement DC-8 radar coverage of ice shelves

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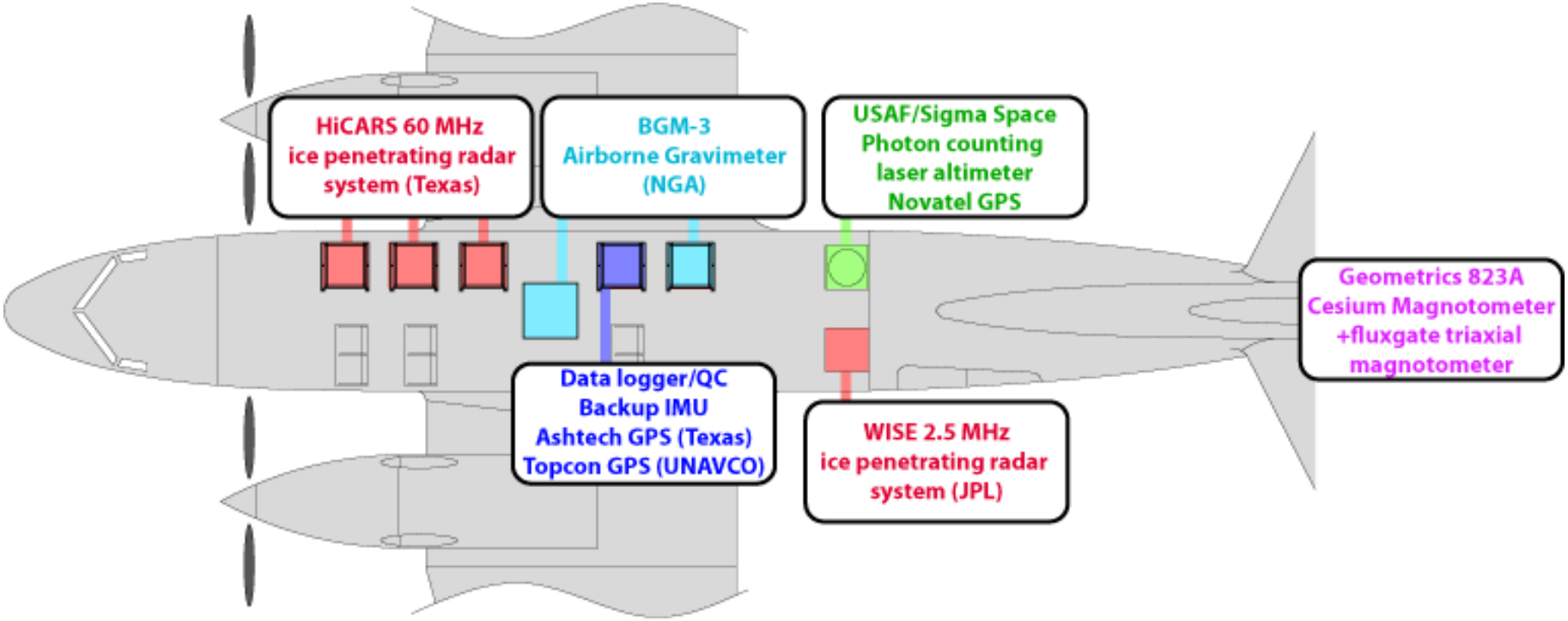
ICECAP instrument suite



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Data status:

HiCARS 60 MHz carrier, 14 MHz bandwidth ice penetrating radar sounder (University of Texas at Austin)

- ~3.3 terrabytes of raw data collected over East Antarctica of which half is ICEBRIDGE targeted
- Loss of dynamic range at Dumont d'Urville due to interference from JPL's WISE radar; does not affect science goals near grounding line
- East Antarctica data is currently en route to Austin for processing (three copies taking separate paths); processing will begin February 1.
- Requires time synchronization to GPS time and calibration to reach Level 1B status
- Data interpretation for ice thickness will require a couple of months for low resolution (~100's of meters horizontal) ice thickness data; procedures are in place. High resolution ice thickness will likely require six to nine months.
- Texas is collaborating with BAS on the BEDMAP II project, which closes for data this April

WISE 2.5 MHz carrier, 1 MHz bandwidth ice penetrating radar sounder (JPL)

- ~50-100 gigabytes of data collected out of Dumont d'Urville
- Most successful season with this experimental system
- Collaborative project with JPL and the University of California-Irvine

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Data status (cont.):

Potential Fields data (Bell BGM-3 Gravimeter, Geometrics 823A Magnetometer, assorted GPS)

- ~5 gigabytes of data collected
- Gravity was not obtained on McMurdo-based ICEBRIDGE flights due to equipment failure
- Requires time synchronization to reach Level 1B status
- Gravity requires precise dual carrier phase GNSS solutions, and manual editing of turbulent zones for free air gravity reduction; estimate a couple of months
- Magnetics requires aircraft compensation using *in situ* field orientation measurements and compensation for diurnal fields; estimate several months at least for a reduced measurement

Surface elevation data (Sigma Space Photon Counting Imaging Lidar; Riegl LD-90 distance meter)

- ~1.6 terabytes of data collected on ICEBRIDGE flights; largely focused of grounding lines and ICESAT tracks; swath estimated at ~400 meters across track.
- Lidar was a prototype system, with some noise issues on one bank of detectors (out of two)
- East Antarctica data is currently en route to Austin for processing (three copies taking separate paths); processing will begin February 1.
- Distance meter requires time synchronization to reach Level 1B status
- Lidar requires range calibration, noise removal and time synchronization to reach Level 1B status
- Surface elevations requires precise dual carrier phase GNSS solutions; estimated a couple of months for distance meter results
- Currently discussing with Sigma Space best approach for final data reduction

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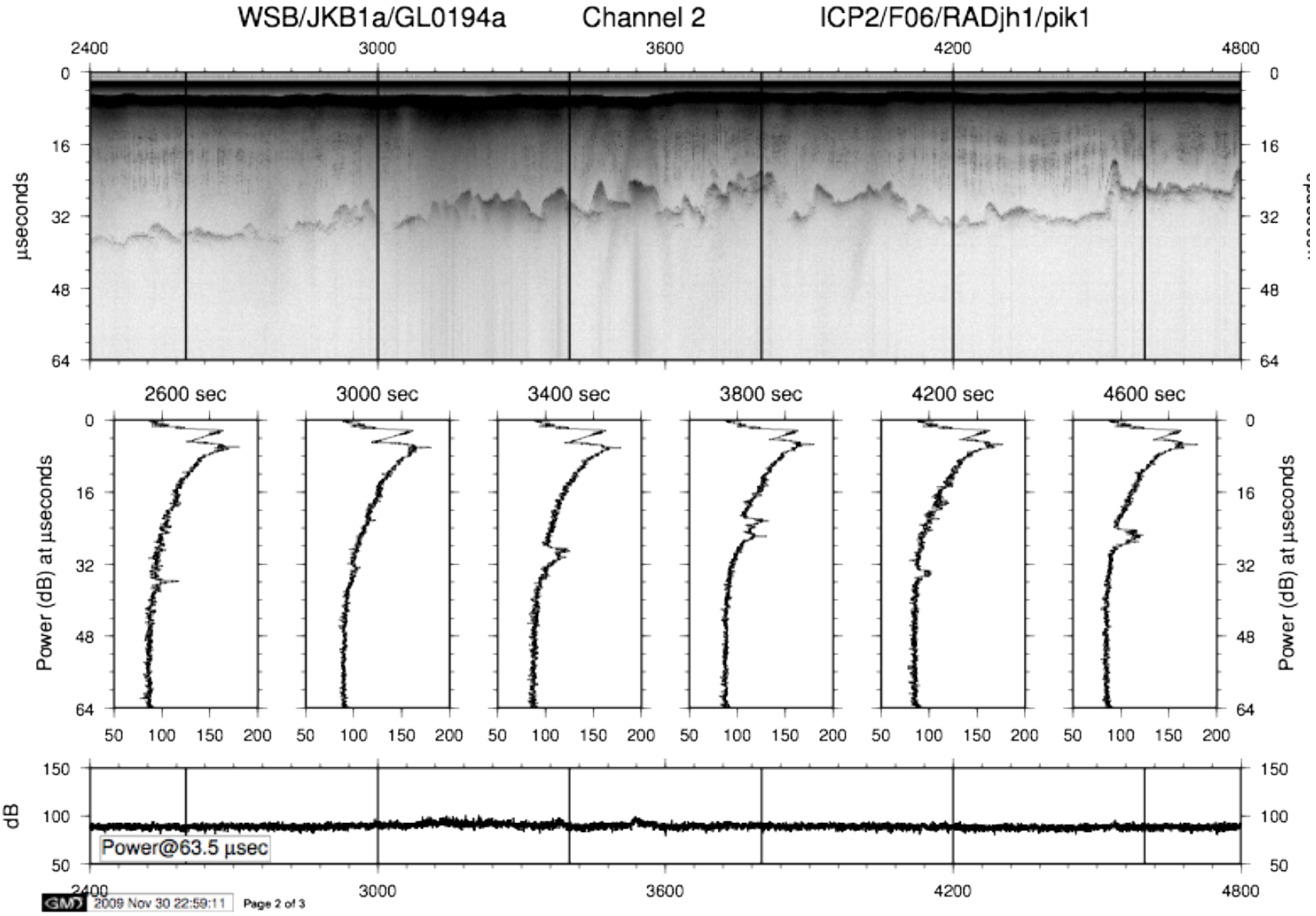
Example HiCARS data from Byrd Glacier



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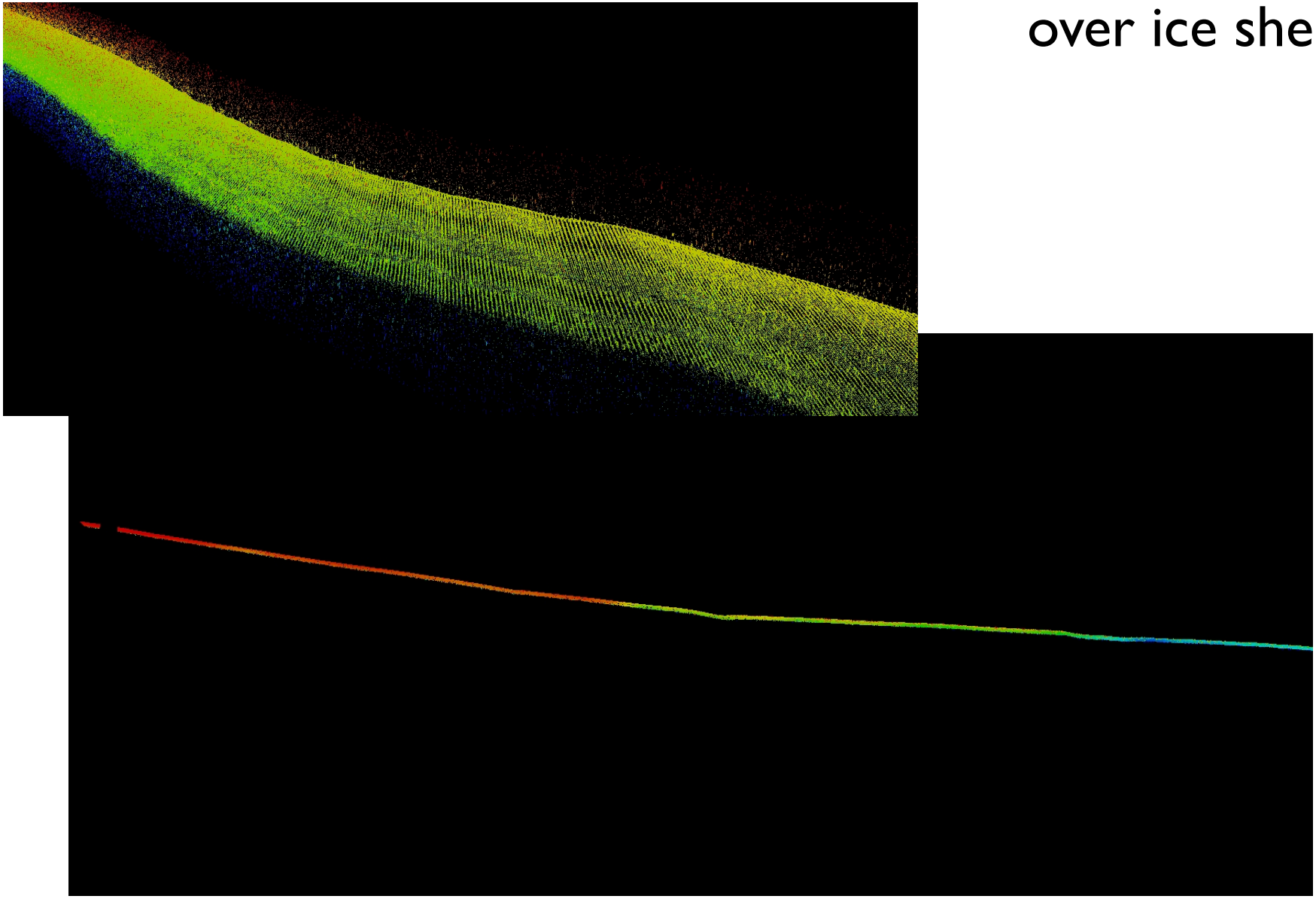
Example Photon Counting Imaging Lidar data over ice sheet



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Summary:

- ICEBRIDGE has achieved sixteen flights, totaling ~25,000 km of data, over East Antarctic targets including Byrd Glacier, Totten Glacier and the Wilkes Coast glaciers
- DC-3T based ICEBRIDGE work is ongoing in the Peninsula
- Data processing is about to begin with the return of data and key personnel in Austin - Level 1B data and positional metadata should be available within a few weeks for most data streams; reduced data should begin becoming available over summer.
- A significant amount of photon counting lidar data was collected - we are developing methods for its processing and distribution
- A copy of all DC-3T based ICEBRIDGE data will be archived at NSIDC during each stage of processing.